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www.gcmgrp-techno.com



Electrical Appliance Solutions



Updated as of June 2021



Company Introduction



PTT Global Chemical Public Company Limited



PTT Global Chemical Public Company Limited, or GC, Thailand's largest integrated petrochemical and refining business and a leading corporation in the Asia-Pacific region, both in size and product variety. GC has a combined olefins and aromatics capacity of 11.28 million tons/year. We committed to creating chemical innovations for a better future. We strongly support technological advances that meet today's lifestyles through products that span several sectors including automobiles, construction, medical products, electric and electronic equipment, agricultural products, environmentally friendly, and safe consumer products that benefit society and improve consumer satisfaction.

www.pttgcgroup.com

GC Styrenics Company Limited



GC Styrenics Company Limited (GCS), subsidiary of PTT Global Chemical Public Company Limited (GC), is a polystyrene manufacturer with more than 30 years operation experiences capable of supplying 90 KTA of products to customers with two production lines producing High Impact Polystyrene (HIPS) and General Purpose Polystyrene (GPPS). These resources are built to prompt our company to strive towards our vision: "To be preferred polystyrene provider for better living" by enabling us to be able to serve our customers with various applications and needs. Our products are well-known under the brand "DIAREX". They are used as raw materials to produce various types of instant products used in everyday life, mostly to form Packaging products, electronic and electrical appliance industry, consumer products and construction application with special properties and characteristic.

HMC Polymers Company Limited



HMC Polymers Company Limited, a subsidiary of PTT Global Chemical Company Limited (GC). The first polypropylene manufacturer in Thailand with the production facilities output over 810,000 metric tons per year and comprise two Spheripol lines and a latest technology Spherizone line from LyondellBasel. We produces a wide range of Moplen polypropylene grades including homopolymer, heterophasic and random copolymer resins, as well as speciality polypropylene resins.

www.hmcpolymers.com



Company Introduction

DynaChisso Thai Company Limited

DynaChisso Thai Company Limited (DYCT) is a joint venture company of Dynachem & Co from Taiwan, PTT Global Chemical Public Company Limited (GC) and Chisso Corporation from Japan with capacity of 25,000 MT/year of total plastic compound.



DYCT and has been located in the Amata Industrial Estate in ChonBuri province of Thailand. Hence, the name of DynaChisso derives from the joint force between Dynachem and Chisso Corporation.

www.dynachisso.com

GC Marketing Solutions Company Limited

GC Marketing Solutions Company Limited (GCM), a subsidiary of PTT Global Chemical Company Limited (GC). GCM is a major polymer sales and marketing company in Thailand. We offer variety of high-quality polymers such as high density polyethylene (HDPE), low density polyethylene (LDPE), linear low density polyethylene (LLDPE), polypropylene (PP), polystyrene (PS) and polyethylene terephthalate (PET). Our products are distributed throughout Thailand as well as being exported to more than 100 countries around the world with the product and services qualities are well accepted by our customers internationally.



www.gcmgrp.com



Solution Creation Company Limited

Solution Creation Company Limited, a subsidiary of PTT Global Chemical Public Company Limited (GC), is a distributor of polymer compound which are high density polyethylene (HDPE), linear low density polyethylene (LLDPE), polypropylene (PP) and polystyrene (PS) compound including bioplastics and bioplastics compound.



GC Logistics Solutions Company Limited

GC Logistics Solutions Company Limited (GCL), a subsidiary of PTT Global Chemical Public Company Limited (GC). GCL is full logistics service for chemical business and other products. The services is including silo, bagging & packing, warehouse management, transportation, freight forwarding, and customs clearance etc. We are committed to strengthen our client's competitive advantage though high quality services, advanced technology and competitive cost.

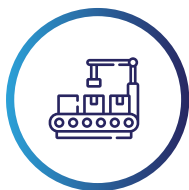


Product Introduction

Business Trends

The need of convenience emerges and grows increasingly from busy lifestyle and the crave for hyperconnectivity. Electrical appliances satisfy those demands since home appliances and office automation are to make life easier and spend time more efficiently. Electronic packaging is somewhat different as it is used to protect electrical parts during transportation. It, therefore, requires better technology to maintain its quality as it is normally exposed to multimodal transportations from production countries to their markets. Global companies, consequently, have to adapt themselves and enhance their products to meet consumer needs which continuously evolve through time.

Value Chain



Converter / Compounder

Benefit to Converter (Production Perspective) :

Our resins are well controlled in quality to provide an advantage of processability, product stability and product consistency which essential for high speed & fast cycle time production.



Brand Owner

Benefit to Branding (Marketing Perspective) :

Our resins deliver high-quality advantages of excellent process stability and catalyst performance which ensures quality of product and strengthen the brand image.



Consumer

Benefit to consumer (User Experience Perspective) :

Our resins have certified standards (JHOSPA, RoSH, UL94, etc.), ensuring that we can deliver finished products that are safe and meet the standards for electrical appliances.

Solutions

Product Quality

DIAREX®

DIAREX PS for E&E is manufactured under international ISO 9001 / ISO 14001 / OHSAS 18001 standard and strictly control for Good Manufacturing Practices (GMP) and Hazard Analysis and Critical Control Point (HACCP) standard.

DIAREX PS for E&E application also meet with international standard regulations

- UL 94, the Standard for Safety of Flammability of Plastic Materials for Parts in Devices and Appliances testing, a plastics flammability standard released by underwriters laboratories
- ROHS, Restriction of Hazardous Substances, the European Union (EU) 2002/95 / EC Regulation on the Use of Hazardous Substances in Electrical and Electronic Equipment. This includes all kinds of appliances on electricity such as television, microwave oven, radio, etc., which means all parts that make up an appliance since the circuit board electronic equipment through the wires must meet the above requirements. The concentration of restricted substances including, lead (Pb), mercury (Hg), cadmium (Cd), hexavalent chromium (Cr), polybrominated biphenyls (PBB) and polybrominated diphenyl ether (PBDE).

Moplen

Moplen PP for E&E is manufactured under international ISO 9001 and ISO14001 standards. Moplen PP for E&E also meets with international standard regulations in contact with food application such as U.S FDA 21 CFR 177.1520, EC1935/2004, EU10/2011 and its amendments, and another country's equivalent regulatory classification.

POLYPRO

POLYPRO PP Compound for E&E

DynaChisso, as one of the direct technological successors of Chisso Corporation, a one-time polyolefin leader in Japan, positions ourselves as an expert in engineered thermoplastics compounding, focusing on polypropylene and other types of polymer.

Established in 2001, DynaChisso has been providing competitively high-quality plastics resins to local manufacturers in automotive, motorcycle, and home-appliances industries, gaining recognizable performance and winning trust among worldwide clients.



Product Introduction

Service Quality

We are also strongly committed to handle and deliver quality resin. We serving our customers with the high-quality products by leveraging our superior manufacturing and R&D capabilities. We believe that the service we provide; the products we offer; the commitment we believe; and the aggressiveness we hold, will achieve win-win successes with our worldwide partners.

GCL, International Distribution Center (IDC) is one of the largest in the Southeast Asian region. It is over 140,000 sq.m. in size and has a capacity to handle the production and delivery of over 1 million tons of polymer per year with most advanced technology under top quality management.

Thus, we provide fully logistics with highly effective integrated Transportation Management System (TMS) spanning across transportation network design, routes selection, vehicle scheduling and freight management to ensure the best results.

How to Handling and Storage

Handling

- Avoid temperatures of 600°F (316°C) or above.
- Handling of plastic may form nuisance dust.
- Protect personnel.
- Pneumatic material handling and processing equipment may generate dust of sufficiently small particle size that, when suspended in air, may be explosive.
- Dust accumulations should be controlled through a comprehensive dust control program that includes, but is not limited to, source capture, inspection and repair of leaking equipment, routine housekeeping and employee training in hazards.
- See NFPA 654.
- Dissipate static electricity during transfer by grounding and bonding containers and equipment before transferring material.
- When handled in bulk quantities, this product and its associated packaging may present a crushing hazard due to the large masses involved, possibly resulting in severe injury or death.
- Avoid contacting molten material with eyes, skin and clothing.
- Ensure good ventilation at the workplace. Always wash hands after handling the product.

Storage

- Keep container dry.
- Keep in a cool place.
- Ground all equipment containing material.
- Keep container tightly closed.
- Keep in a cool, well-ventilated place, dust-free and well-ventilated area at temperature below 50°C.
- Protect from heat, direct sunlight and rain.
- Combustible materials should be stored away from extreme heat and away from strong oxidizing agents.

Advice on general occupational hygiene

Eating, drinking and smoking should be prohibited in areas where this material is handled, stored and processed.

Packaging materials

- Store only in the original container.
- Keep container tightly closed and sealed until ready for use.
- Containers that have been opened must be carefully resealed and kept upright to prevent leakage.
- Do not store in unlabeled containers.
- Use appropriate containment to avoid environmental contamination.

Materials to avoid

Store away from incompatible substances, flammable substances and oxidizing agents.

DIAREX® GRADE Selection : PS

| Properties | Test Method | Unit | THH102 | THH103 | THF77 |
|--|-------------|--|-------------------|-------------------|------------------|
| Physical Properties | | | | | |
| Melt Flow Rate (200 °C, 5 kg) | ASTM D1238 | g/10 min | 2.6 | 1.7 | 8.4 |
| Specific gravity | ASTM D792 | g/cm ³ | 1.05 | 1.05 | 1.05 |
| Vicat Softening Point (1kg) | ASTM D1525 | °C °F | 106 223 | 107 225 | 101 214 |
| Deflection Temperature (18.56 kg/cm ²) | ASTM D648 | °C °F | 81 178 | 82 180 | 78 172 |
| Mechanical Properties | | | | | |
| Tensile Strength @ Yield | ASTM D638 | kg/cm ² lb/in ² | 530 7,500 | 543 7,700 | 470 6,700 |
| Tensile Elongation | ASTM D638 | % | 2.5 | 2.6 | 2 |
| Izod Impact Strength | ASTM D256 | kg.cm/cm ft.lb/in | 2.2 0.4 | 2.2 0.4 | 2.2 0.4 |
| Rockwell Hardness | ASTM D785 | Scale | M80 | M80 | M80 |
| Underwriter Laboratory | | | UL-94HB | UL-94HB | UL-94HB |
| Type | | | GPPS High Heat | GPPS High Heat | GPPS Standard |

DIAREX® GRADE Selection

| Properties | Test Method | Unit | H350E | H350 | H370 | H950 |
|--|-------------|--|---------------------|---------------------|---------------------|--------------------|
| Physical Properties | | | | | | |
| Melt Flow Rate (200 °C, 5 kg) | ASTM D1238 | g/10 min | 2.6 | 3.5 | 5.0 | 3 |
| Specific gravity | ASTM D792 | g/cm ³ | 1.04 | 1.04 | 1.04 | 1.04 |
| Vicat Softening Point (1kg) | ASTM D1525 | °C °F | 101 213 | 104 219 | 100 212 | 105 221 |
| Deflection Temperature (18.56 kg/cm ²) | ASTM D648 | °C °F | 76 169 | 78 172 | 74 165 | 79 174 |
| Gloss (60° Gardner) | ASTM D523 | % | - | - | - | 90 |
| Mechanical Properties | | | | | | |
| Tensile Strength @ Yield | ASTM D638 | kg/cm ² lb/in ² | 281 4000 | 298 4,250 | 281 4,000 | 345 4,900 |
| Tensile Elongation | ASTM D638 | % | 53 | 55 | 40 | 50 |
| Flexural Strength | ASTM D790 | kg/cm ² lb/in ² | 386 5,500 | 386 5,500 | 394 5,600 | 457 6,500 |
| Flexural Modulus (x10,000) | ASTM D790 | kg/cm ² lb/in ² | 1.8 26 | 1.9 27 | 3 43 | 1.8 26 |
| Izod Impact Strength | ASTM D256 | kg.cm/cm ft.lb/in | 11 2 | 11 2 | 10 1.8 | 11 2 |
| Rockwell Hardness | ASTM D785 | Scale | R112 | R112 | R112 | R112 |
| Underwriter Laboratory | | | UL-94HB | UL-94HB | UL-94HB | UL-94HB |
| Type | | | HIPS High Impact | HIPS High Impact | HIPS High Impact | HIPS High Gloss |

GRADE Selection : PP

GRADE Selection : PS and PP Compound

| Item | Test Method (ASTM) | Unit | Grade HP648N | Grade HP500D | Grade HP348N | Grade HP341R | Grade HP380T | Grade HP549T |
|--------------------------------------|--------------------|---------|--------------|--------------|------------------|-------------------------|-------------------------|-------------------------|
| PP type | - | - | Homo polymer | Homo polymer | Random Copolymer | Heterophasic Copolymers | Heterophasic Copolymers | Heterophasic Copolymers |
| MFR at 230°C, 2.16 kg | D1238 | g/10min | 12 | 0.5 | 11 | 24 | 44 | 60 |
| Density | D792B | g/cm³ | 0.90 | 0.90 | 0.90 | 0.90 | 0.90 | 0.90 |
| Tensile strength at yield | D638 | MPa | 38 | 35 | 29 | 24 | 24 | 26 |
| Flexural modulus | D790A | MPa | 1870 | 1560 | 1050 | 1150 | 1150 | 1500 |
| Notched Izod impact strength at 23°C | D256A | J/m | 32 | 104 | 70 | 60 | 64 | 40 |
| Deflection temperature at 455kPa | D648 | °C | 122 | 103 | 86 | 96 | 90 | 115 |

GRADE Selection : PS and PP Compound

| Item | Unit | Test Method (ASTM) | C1809PJ-02 |
|---|---------|--------------------|------------|
| MFR at 190°C, 2.16 kg | g/10min | D1238 | 5 |
| Density (g/cm3) | g/cm³ | D792 | 1.33 |
| Flexural Modulus (kg/cm3) | Mpa | D790 | 12,000 |
| Notched Izod Impact at 23 OC (kg.cm/cm) | J/m | D256 | 100 |
| Tensile strength at break | MPa | D638 | 120 |
| Strain at break | % | D638 | 2 |
| Rockwell hardness | Scale R | D785 | 107 |

| Item | Unit | Test Method (ASTM) | PS07002H |
|---|------------|--------------------|-----------------------------------|
| Flow rate (200 °C, 5 kg) | g/10 min | ASTM D1238 | 7.2 |
| Density (at 23 °C) | g/cm³ | ASTM D792 | 1.03 |
| Tensile strength at max* | MPa | ASTM D882 | 23 |
| Tensile elongation at break* | % | ASTM D882 | 40 |
| Impact strength, notched Izod (at 23°C) | kJ/m² | ASTM D256 | 10 |
| Vicat softening point | °C | ASTM D1525 | 89 |
| Surface resistivity (at 23 °C, 50 %RH) | Ohm/square | ASTM D257-14 | 10 ⁸ -10 ¹⁰ |

| Item | Unit | Test Method (ASTM) | S908C |
|---|------------|--------------------|----------------------------------|
| Flow rate (200°C, 5 kg) | g/10 min | ASTM D1238 | 2.23 |
| Density (at 23°C) | g/cm³ | ASTM D792 | 1.11 |
| Tensile strength at Yield | MPa | ASTM D638-02a | 30.5 |
| Tensile elongation at break | % | ASTM D638-02a | 28 |
| Elastic modulus | MPa | ASTM D638-02a | 1940 |
| Flexural strength@5%strain | MPa | ASTM D790-17 | 54.2 |
| Flexural modulus | MPa | ASTM D790-17 | 2480 |
| Impact strength, notched Izod (at 23°C) | J/m | ASTM D256-03 | 168 |
| Vicat softening point | °C | ASTM D1525-00 | 89.4 |
| Heat deflection temperature | °C | ASTM D648 | 78.6 |
| Surface resistivity (at 23°C, 50 %RH) | Ohm/square | ASTM D257-14 | 10 ³ -10 ⁵ |

POLYPRO

GRADE Selection : PP Compound

| Properties | Test | Condition | Unit | Flame Retardant | Talcum | Talcum | Glass Fiber | Glass Fiber | Glass Fiber | Glass Fiber | Multi |
|--|-----------|------------------------|------------------------|-----------------|------------|------------|-------------|-------------|-------------|-------------|---------------------------|
| | Method | | | 難燃 | タルク | タルク | ガラス | ガラス | ガラス | ガラス | 複合フィラー |
| 物性 | 測定方法 | 測定条件 | 単位 | 2527 | CT-110 | CL5351 | T007 | GF03X | GCS30R | GC232T | SS22X |
| Specific Gravity 比重 | ASTMD792 | Molding Piece | g/cm ³ | 0.97 | 0.96 | 1.00 | 1.01 | 1.04 | 1.12 | 1.12 | 1.06 |
| Melt Flow Rate 流動性 | ASTMD1238 | 230 °C /2.16kgf | g/10min | 8.0 | 37.0 | 30.0 | 4.0 | 3.8 | 6.0 | 3.6 | 9.5 |
| Tensile Strength 引張強度 | ASTMD638 | 50mm/min | MPa | 30 | 30 | 28 | 65 | 67 | 85 | 110 | 30 |
| Elongation at Break 引張破断点伸び | ASTMD638 | 50mm/min | % | 100 | 10 | 15 | 4 | 4 | 9 | 11 | 30 |
| Flexural Strength 曲げ強度 | ASTMD790 | 1.3mm/min | MPa | 45 | 40 | 40 | 115 | 100 | 120 | 141 | 30 |
| Flexural Modulus 曲げ弾性率 | ASTMD790 | 1.3mm/min | MPa | 1,274 | 2,000 | 2,300 | 3,100 | 3,830 | 5,700 | 6,904 | 2,000 |
| Izod Impact Strength アイゾット衝撃強度 | ASTMD256 | Notched 23°C | kgf cm/cm ² | 8.0 | 3.0 | 4.0 | 4.2 | 7.7 | 6.5 | 11.5 | 2.5 |
| Rockwell Hardness ロックウェル硬さ | ASTMD785 | Rockwell | R-SCALE | 90 | 95 | 90 | 103 | 105 | 108 | 104 | 95 |
| Heat Distortion Temperature 荷重たわみ温度 | ASTMD648 | 4.6kgf/cm ² | °C | 105 | 125 | 125 | 149 | 150 | 150 | 158 | 110 |
| Ash Content 灰分率 | ASTMD2584 | | % | - | 10% (Talc) | 13% (Talc) | 15% (GF) | 20% (GF) | 30% (GF) | 30% (GF) | 5% (Talc) 15% (Barium) |
| Flammability 燃焼性 | UL94 | | CLASS (mm) | UL V-0 (0.8mm) | - | - | - | - | - | - | - |

POLYPRO

GRADE Selection : PP Compound

| Properties 物性 | Test | Condition 測定条件 | Unit 単位 | General | Flame Retardant |
|--|----------------|------------------------|------------------------|---------|-----------------|
| | Method 測定方法 | | | 一般 | 難燃 |
| | | | | EK0819 | 2038 |
| Specific Gravity 比重 | ASTMD792 | Molding Piece | g/cm ³ | 0.90 | 0.98 |
| Melt Flow Rate 流動性 | ASTMD1238 | 230 °C /2.16kgf | g/10min | 40.0 | 9.6 |
| Tensile Strength 引張強度 | ASTMD638 | 50mm/min | MPa | 25 | 31 |
| Elongation at Break 引張破断点伸び | ASTMD638 | 50mm/min | % | 400 | 55 |
| Flexural Strength 曲げ強度 | ASTMD790 | 1.3mm/min | MPa | 25 | 47 |
| Flexural Modulus 曲げ弾性率 | ASTMD790 | 1.3mm/min | MPa | 900 | 1,579 |
| Izod Impact Strength アイゾット衝撃強度 | ASTMD256 | Notched 23°C | kgf cm/cm ² | 3.5 | 7.4 |
| Rockwell Hardness ロックウェル硬さ | ASTMD785 | Rockwell | R-SCALE | 80 | 95 |
| Heat Distortion Temperature 荷重たわみ温度 | ASTMD648 | 4.6kgf/cm ² | °C | 100 | 115 |
| Ash Content 灰分率 | ASTMD2584 | | % | - | - |
| Flammability 燃焼性 | UL94 | | CLASS (mm) | - | UL V-0 (0.8mm) |